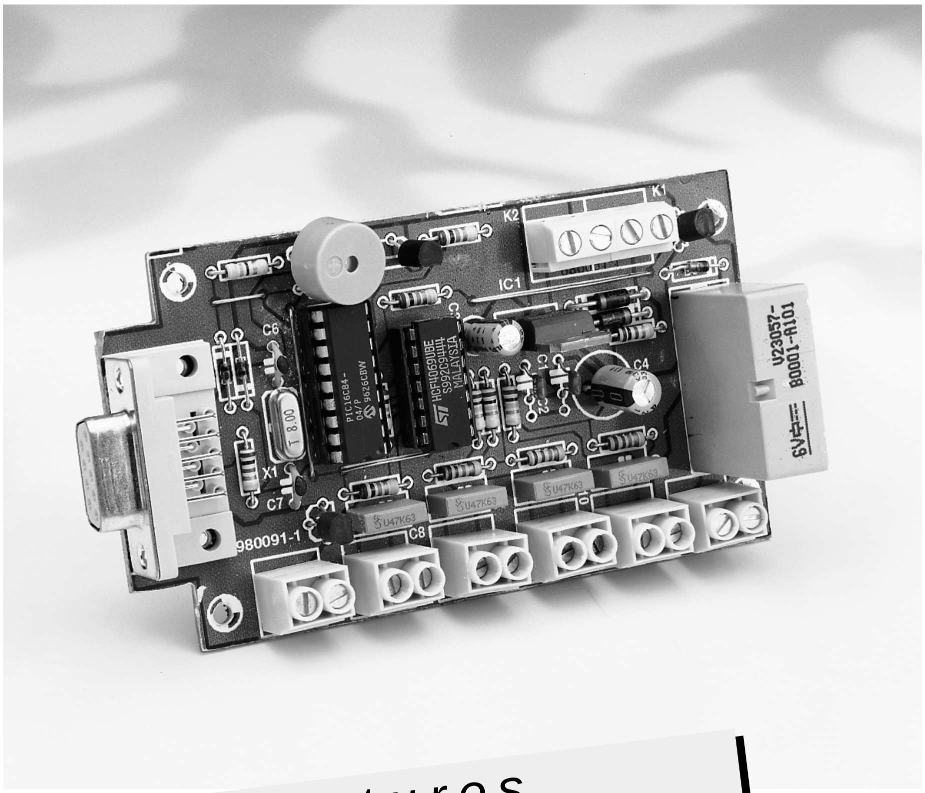
home alarm system

programmable burglar deterrent with a PC interface

Crime in general is still on the rise, and having an alarm system installed is no longer a privilege of the wealthy. This article shows that an advanced alarm system to protect your home and valuables can be very compact indeed. Using the PC, the authorized user is able to program the main parameters of the alarm system.



Main features

Processor:	PIC17-6F84
Serial port:	19,200 bits/s
Inputs:	direct and delayed
Outputs:	relay for siren
User indication:	buzzer
Alarm contacts:	normally closed
Interface for optional phone dialler	
Key switch to arm system	
Actuation delay (default):	20 seconds
Siren on time:	1 to 255 seconds
Adjustable actuation delay:	1 to 99 seconds
‘Armed’ indicator	
Battery back-up	

Design by H. Sommen

By popular demand, PIC processors and alarm systems are two subjects which are often covered in this magazine. In this article, you find the two combined in a programmable alarm system for home construction. Here, a PIC processor is employed as the logic 'glue' between the various sensors (detection devices) and alarm actuators. Besides this function, the PIC also handles all communication between the alarm system and an (optional) PC of the IBM/compatible type.

Using a simple RS232 link and a standard terminal program, the main parameters of the alarm, including alarm time, may be programmed.

Optionally, the alarm may be extended with a separate telephone dialler, which allows 'silent signalling' to be implemented. The relevant hardware is not discussed in this article, but we intend to cover it in a future issue of *Elektor Electronics*. A commercially available dialler unit may be connected to a dedicated output on the alarm system. If the alarm goes off, transistor T1 will conduct for about one second — long enough to actuate an external dialler.

THE APPROACH

The circuit diagram of the home alarm system is given in **Figure 1**. The connections to the various alarm detection devices have been kept as simple and universal as possible. Assuming that devices with normally-closed (nc) contacts are used, buffer inputs (IC3a-IC3d) are pulled low via a group of connection terminals (K3, K6, K7, K8). A pull-up resistor and a 470-nF afford ample noise suppression.

1

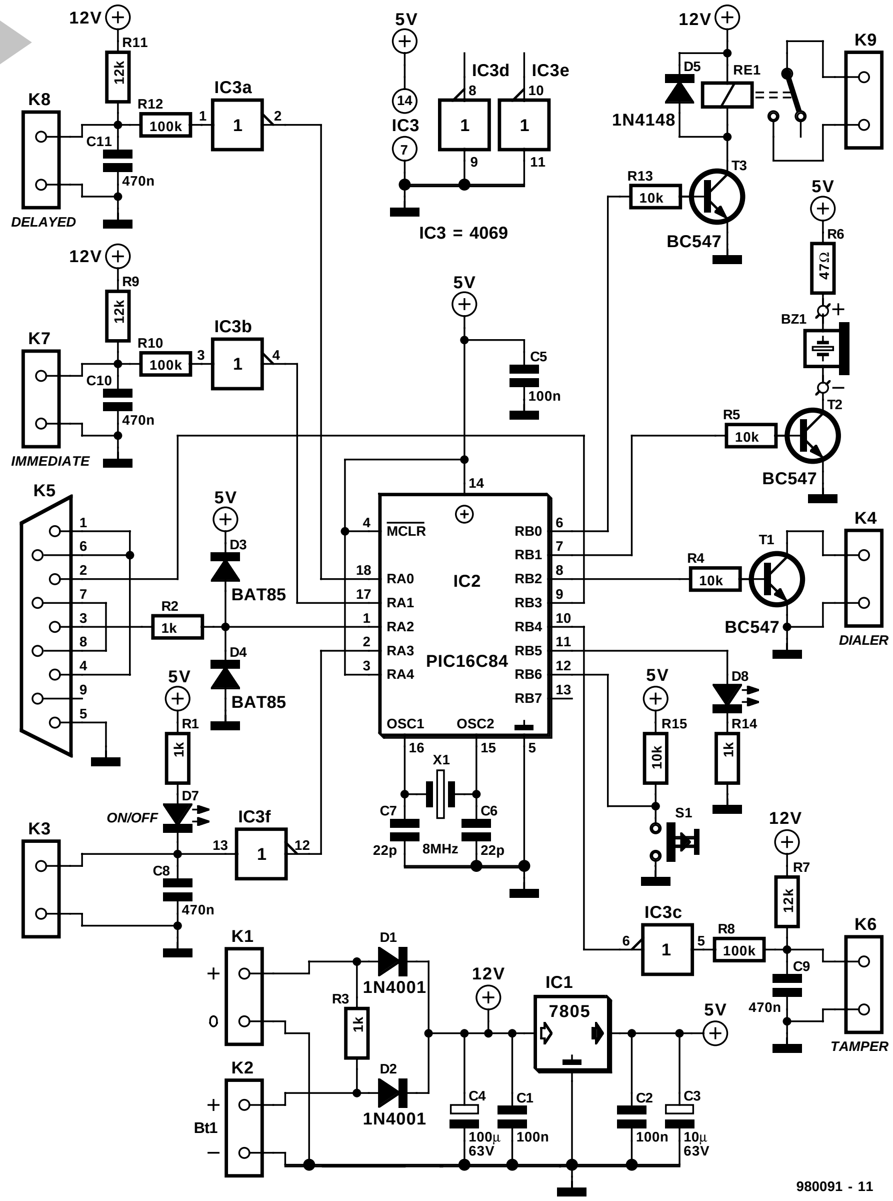


Figure 1. The program stashed away in the PIC processor allows the hardware to be kept very simple indeed.

The connection point of the main switch (K3) has an extra indicator. If LED D6 is on, the alarm system is armed. This input is therefore best connected to a key switch.

The detection device connected to terminal block K8 is 'interpreted' with an adjustable delay (for example, 20 seconds). When the alarm is armed, an integrated buzzer starts to sound to indicate that a contact in this group is opened within the delay period. This delay is needed to leave the building without setting off the alarm. The door you normally use to leave the building is therefore connected to the 'delayed' input.

When you enter the building, the same delay is available to de-activate the alarm. However, the buzzer will not sound during this period to prevent it giving away the location of the alarm control unit.

The alarm contacts connected-up to terminal block K7 produce an instant alarm when opened. The upshot is that all 'nc' detection devices are connected in series and to this input. If any one of the switches is opened, the detection loop is interrupted, and the alarm is set off.

The last input is the 'tamper' input. The switch protecting the alarm enclosure is connected to this input. If someone attempts to open the enclosure while the alarm is in the 'armed' state, this will not go unnoticed because the alarm will go off.

The alarm actuator (for example, a siren) is switched by relay Re1. This relay will be energized for a programmable period when an alarm condition is detected. The default 'on' time is 180 seconds. Using the PC, however, you may set any period between 1 and 255 seconds.

If an alarm condition has occurred, and the siren has been switched off, LED D8 will remain on. In this way, when you come home, you are informed that the alarm went off at least once during your absence. The LED activity can be cleared by pressing reset button S1.

What remains to be discussed at this point are the connections of the power supply and the lead-acid battery. The power supply (approx. 13 V) has to be connected to terminal block K1, while the 12-V lead-acid battery goes to K2. The battery is kept topped up via resistor R3. The three-pin regulator in the power supply section provides the correct supply voltage for the microcontroller in the alarm control unit.

The battery used in the alarm system should have sufficient capacity to power the alarm control unit, the siren (or flashlight) and the telephone dialler. The battery is incorporated in the design to ensure that the alarm system keeps working when the mains electricity system is tampered with by burglars.

2

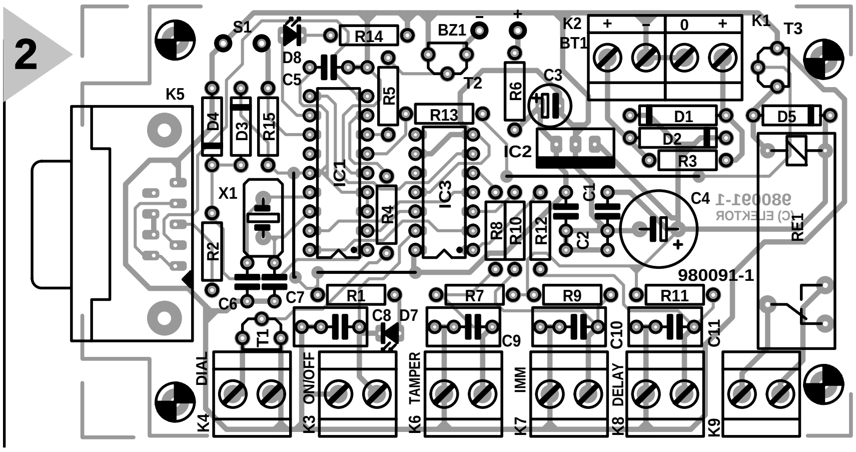


Figure 2. Copper track layout and component mounting plan of the printed circuit board designed fore the alarm system.

COMPONENTS LIST

Resistors:
R1,R2,R3,R14 = 1kΩ
R4,R5,R13,R15 = 10kΩ
R6 = 47Ω
R7,R9,R11 = 12kΩ
R8,R10,R12 = 100kΩ

Capacitors:
C1,C2,C5 = 100nF
C3 = 10μF 63V radial
C4 = 100μF 63V radial
C6,C7 = 22pF
C8,C9,C10,C11 = 470nF

Semiconductors:
D1,D2 = 1N4001
D3,D4 = BAT85
D5 = 1N4148
D6,D7 = LED, red, high efficiency
T1,T2,T3 = BC547

3

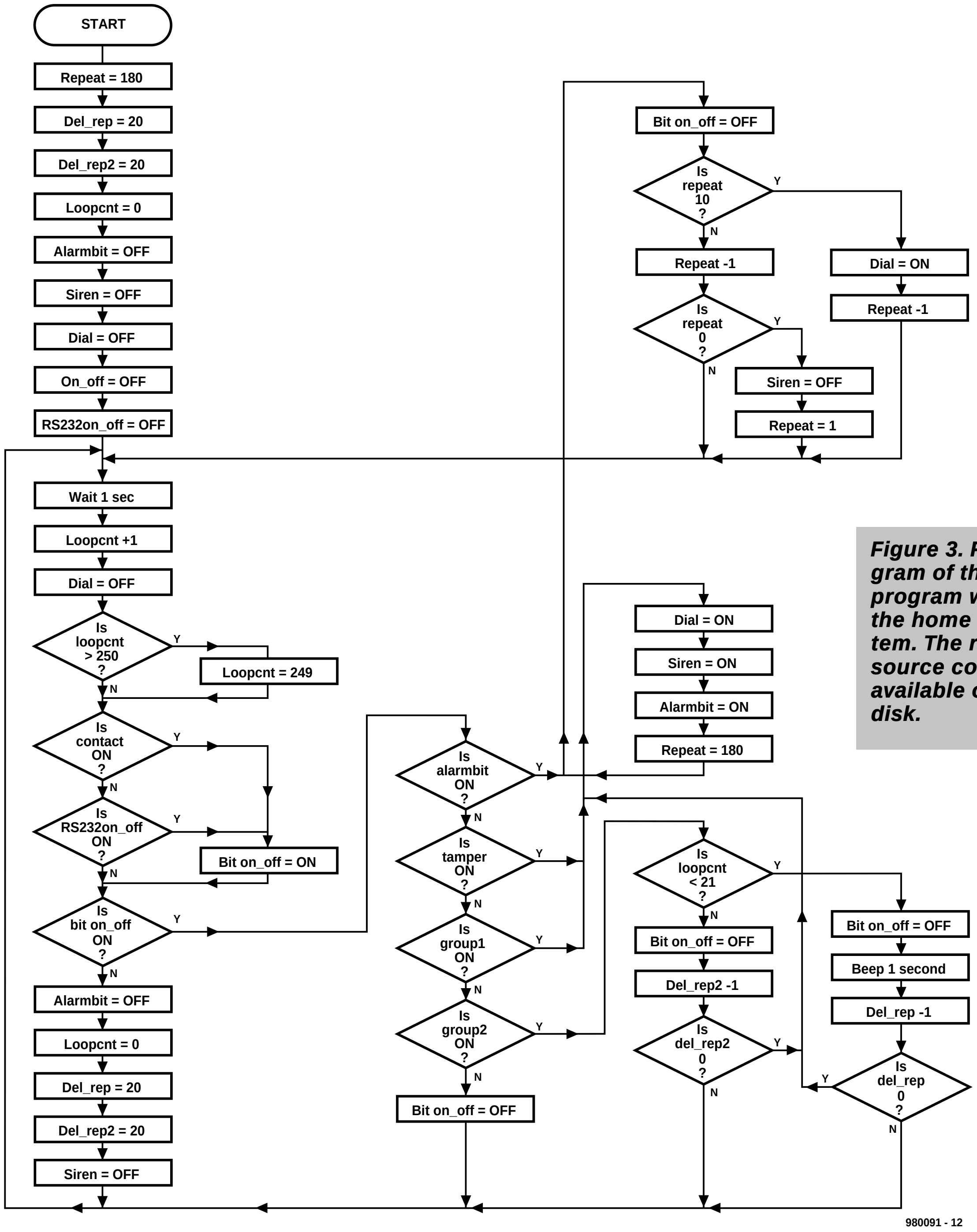
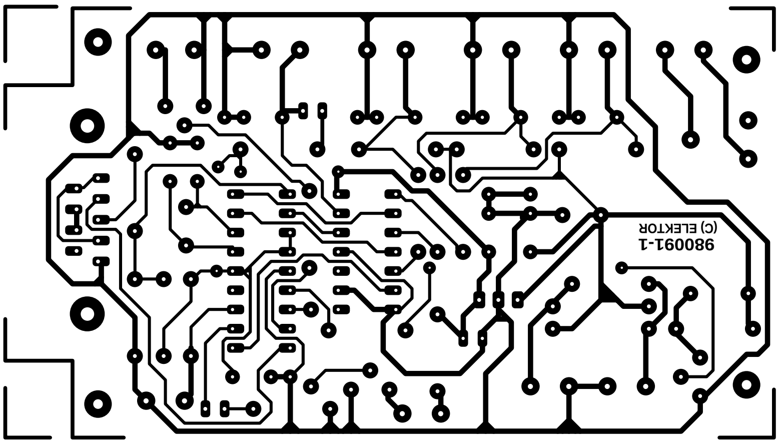


Figure 3. Flow diagram of the main program written for the home alarm system. The relevant source code file is available on floppy disk.

IC1 = PIC16F84
(order code 986519-1)
IC2 = 7805
IC3 = 4069

Miscellaneous:
K1-K4,K6-K9 = 2-way PCB terminal block, raster 5mm
K5 = 9-way sub-D socket (female), PCB mount, angled pins
Bz1 = piezo buzzer, 5V DC
X1 = 8 MHz quartz crystal
S1 = push-button, 1 make contact
Re1 = 12-V relay, 1 change-over contact (e.g., Siemens V23057-B0001-A002)
PCB, PIC and floppy disk (set), order code 980091-C
PCB only, order code 980091-1
Source code disk only, order code 986028-1.



OPTIONAL PC CONTROL

Serial communication with your PC takes place via 9-way connector K5. On the printed circuit board, all relevant handshaking signals are available, allowing a standard (commercially available) RS232 cable to be used. Resistor R2 and diodes D3 and D4 convert the RS232 signal levels on the interface into TTL levels that can be processed by the alarm circuit.

CONSTRUCTION

Building this circuit should not present problems because a ready-made high-quality printed circuit board (PCB) is available from the Publishers (see the Components List, and the Readers Services page elsewhere in this issue). The copper track layout and component-mounting plan of this compact board are given in **Figure 2**.

SILICON HEART

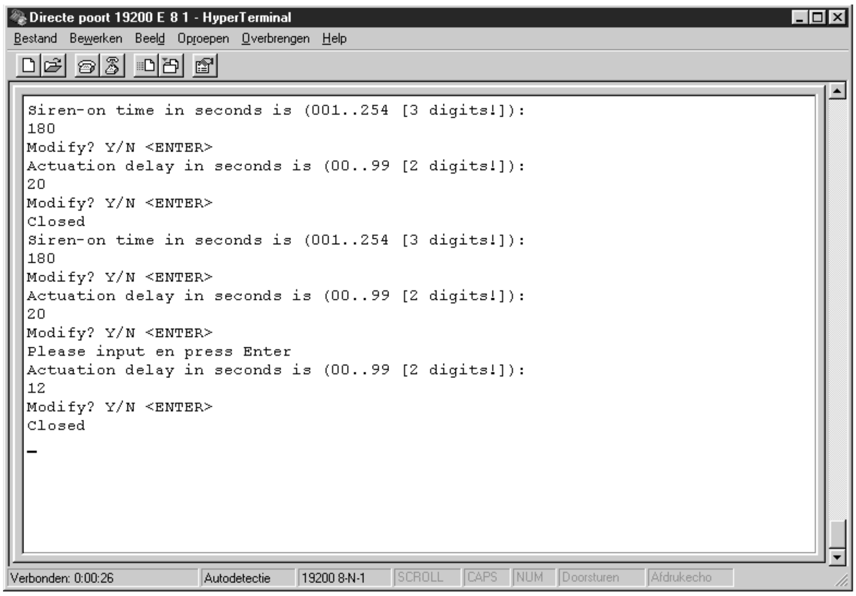
The PIC processor in the present project underlines the fact that microcontrollers allow loads of functionality to be combined in a single compact case. Here, the processor ticks at a rate of 8 MHz.

The control software programmed into controller ROM consists of a large loop which is repeated every second. As shown by the flow diagram in **Figure 3**, the basic structure of the program boils down to continuous testing of bits and/or input levels. Based on the results of these ‘interrogation’ activities, the processor determines whether or not an alarm condition has to be signalled. Because the program has a relatively simple structure, new features are easily added with the aid of the source code file, which is available separately on floppy disk (order code **986028-1**).

Serial communication between the PC and the alarm control unit is only possible in ‘standby’ mode, i.e., when the switch contact on K3 is open. Run a terminal program on your PC (or connect a real ‘dumb’ terminal), and select these communication parameters:
19,200 bits/s, even parity, 8 databits and 1 stopbit.
‘Local echo’ should be enabled on the terminal. Press the Return key and follow the instructions on the screen. The new parameters are effective after you switch the alarm control off and on again. The screendump in Figure 4 shows the information which should appear on the terminal display.

(980091-1)

Figure 4. The home alarm system is easy to program if you have a terminal or a PC running a communication program like Telix, ProComm or HyperTerminal.


Directe poort 19200 E 8 1 - HyperTerminal
Bestand Bewerken Beeld Oproepen Overbrengen Help
Verbonden: 0:00:26
Autodetectie
19200 8-N-1
SCROLL
CAPS
NUM
Doorsturen
Afdrukecho

```
Siren-on time in seconds is (001..254 [3 digits!]):
180
Modify? Y/N <ENTER>
Actuation delay in seconds is (00..99 [2 digits!]):
20
Modify? Y/N <ENTER>
Closed
Siren-on time in seconds is (001..254 [3 digits!]):
180
Modify? Y/N <ENTER>
Actuation delay in seconds is (00..99 [2 digits!]):
20
Modify? Y/N <ENTER>
Please input en press Enter
Actuation delay in seconds is (00..99 [2 digits!]):
12
Modify? Y/N <ENTER>
Closed
_
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